

## Claims

- [c1] What is the claimed is:
- 1.A method for manufacturing a light emitting diode having a transparent substrate, the method comprising:  
forming a semiconductor multilayer on a first substrate producing a first multilayer structure;  
forming an amorphous interface layer on a second substrate, the second substrate being transparent in nature, producing a second multilayer structure;  
bonding the first multilayer structure to the second multilayer structure,  
producing a third multilayer structure; and  
removing the first substrate from the third multilayer structure.
- [c2] 2.The method of claim 1 further comprising a step of forming a transparent conductive layer on the third multilayer structure after removing the first substrate.
- [c3] 3.The method of claim 1, wherein the amorphous interface layer is made of at least one selected from a group comprising indium tin oxide, indium cadmium oxide, indium tin oxide, and transparent conductive adhesive agent.
- [c4] 4.A method for manufacturing a light emitting diode, comprising:  
forming a semiconductor multilayer on a first substrate producing a first multilayer structure;  
forming an amorphous interface layer on a second substrate, the second substrate being transparent in nature, producing a second multilayer structure;  
bonding the first multilayer structure to the second multilayer structure,  
producing a third multilayer structure; and  
removing the first substrate from the third multilayer structure.
- [c5] 5.The method of claim 4 further comprising a step of forming a transparent conductive layer on the third multilayer structure after removing the first substrate.
- [c6] 6.The method of claim 4, wherein the amorphous interface layer is made of at least one selected from a group comprising indium tin oxide, cadmium tin

oxide, antimony tin oxide, and transparent conductive adhesive agent.

- [c7] 7.A light emitting diode having a transparent substrate, the light emitting diode comprising:
- a transparent substrate;
  - an amorphous interface layer formed on the transparent substrate;
  - a top surface of the amorphous interface layer comprising a first surface region and a second surface region;
  - a p<sup>+</sup>-type contact layer formed on the first surface region;
  - a p-type cladding layer formed on the p<sup>+</sup>-type contact layer;
  - a multiple quantum well (MQW) light-emitting layer formed on the p-type cladding layer;
  - an n-type cladding layer formed on the MQW light-emitting layer;
  - an n-type stop layer formed on the n-type cladding layer;
  - a transparent conductive layer formed on the n-type stop layer;
  - a first electrode formed on the transparent conductive layer; and
  - a second electrode formed on the second surface region.
- [c8] 8.A light emitting diode having a transparent substrate, the light emitting diode comprising:
- a transparent substrate comprising sapphire;
  - an amorphous interface layer formed on the transparent substrate, a top surface of the amorphous interface layer comprising a first surface region and a second surface region;
  - a contact layer of p<sup>+</sup>-type GaAs formed on the first surface region;
  - a p-type cladding layer of p-type AlGaN<sub>x</sub>P formed on the contact layer.
- [c9] a light-emitting layer of AlGaN<sub>x</sub>P formed on the p-type cladding layer;
- an n-type cladding layer of n-type AlGaN<sub>x</sub>P formed on the light-emitting layer;
- a stop layer of n-type AlGaAs formed on the n-type cladding layer;
- an ITO transparent conductive layer formed on the stop layer.
- [c10] a first electrode formed on the ITO transparent conductive layer.
- [c11] a second electrode formed on the second surface region.

- [c12] 9.A light emitting diode having a transparent substrate, the light emitting diode comprising:  
an ohmic contact electrode;  
a p-type transparent substrate formed on the ohmic contact electrode;  
a first p<sup>+</sup>-type contact layer formed on the transparent substrate;  
an amorphous interface layer formed on the first p<sup>+</sup>-type contact layer;  
a second p<sup>+</sup>-type contact layer formed on the amorphous interface layer;  
a p-type cladding layer formed on the second p<sup>+</sup>-type contact layer;  
a light-emitting layer formed on the p-type cladding layer;  
an n-type cladding layer formed on the light-emitting layer;  
an n-type stop layer formed on the n-type cladding layer;  
a transparent conductive layer formed on the n-type stop layer; and  
a first electrode formed on the transparent conductive layer.
- [c13] 10.A light emitting diode having a transparent substrate, the light emitting diode comprising:  
an ohmic contact electrode;  
a p-type GaP transparent substrate formed on the ohmic contact electrode;  
a first p<sup>+</sup>-type contact layer of p<sup>+</sup>-type GaAs formed on the p-type GaP transparent substrate;  
an indium tin oxide amorphous interface layer formed on the first p<sup>+</sup>-type contact layer;  
a second p<sup>+</sup>-type contact layer of p<sup>+</sup>-type GaAs formed on the indium tin oxide amorphous interface layer;  
a p-type cladding layer of a p-type AlGaNp formed on the second p<sup>+</sup>-type contact layer;  
a multiple quantum well light-emitting layer of AlGaNp formed on the p-type cladding layer;  
an n-type cladding layer of n-type AlGaNp formed on the light-emitting layer;  
a stop layer of n-type AlGaAs formed on the n-type cladding layer;  
an ITO transparent conductive layer formed on the stop layer;  
a first electrode formed on the ITO transparent conductive layer.
- [c14] 11.A light emitting diode having a transparent substrate, the light emitting

diode comprising:

- a first electrode;
- an n-type transparent substrate formed on the first electrode;
- an amorphous interface layer formed on the n-type transparent substrate;
- an n-type contact layer formed on the amorphous interface layer;
- an n-type cladding layer formed on the n-type contact layer;
- a light-emitting layer formed on the n-type cladding layer;
- a p-type cladding layer formed on the light-emitting layer;
- a p-type buffer layer formed on the p-type cladding layer;
- a p<sup>+</sup>-type contact layer formed on the p-type buffer layer;
- a transparent conductive layer formed on the p<sup>+</sup>-type contact layer; and
- a second electrode formed on the transparent conductive layer.

- [c15] 12.A light emitting diode having a transparent substrate, the light emitting diode comprising:
- a first electrode;
  - a transparent substrate of n-type GaP formed on the first electrode;
  - an indium tin oxide (ITO) amorphous interface layer formed on the transparent substrate of n-type GaP;
  - a contact layer of n-type GaP formed on the ITO amorphous interface layer;
  - a cladding layer of n-type AlGaN<sub>P</sub> formed on the contact layer of n-type GaP;
  - a multiple quantum well (MQW) light-emitting layer of AlGaN<sub>P</sub> formed on the cladding layer of n-type AlGaN<sub>P</sub>;
  - a cladding layer of p-type AlGaN<sub>P</sub> formed on the MQW light-emitting layer of AlGaN<sub>P</sub>;
  - a buffer layer of p-type AlGaAs formed on the cladding layer of p-type AlGaN<sub>P</sub>;
  - a contact layer of p<sup>+</sup>-type GaAs formed on the buffer layer of p-type AlGaAs;
  - an ITO transparent conductive layer formed on the contact layer of p<sup>+</sup>-type GaAs; and
  - a second electrode formed on the ITO transparent conductive layer.

- [c16] 13.A light emitting diode having a transparent substrate, the light emitting diode comprising:
- a transparent substrate;

an amorphous interface layer formed on the transparent substrate, a top surface of the amorphous interface layer comprising a first surface region and a second surface region;

an  $n^+$ -type reverse-tunneling contact layer formed on the first surface region; a p-type cladding layer of formed on the  $n^+$ -type reverse-tunneling contact layer;

a light-emitting layer formed on the p-type cladding layer;

an n-type cladding layer formed on the light-emitting layer;

a first contact electrode formed on the n-type cladding layer; and

a second electrode formed on the second surface region.

[c17] 14. A light emitting diode having a transparent substrate, the light emitting diode comprising:

a transparent substrate comprising glass;

an indium tin oxide (ITO) amorphous interface layer formed on the transparent substrate, a top surface of the ITO amorphous interface layer comprising a first surface region and a second surface region;

a reverse-tunneling contact layer of  $n^+$ -type InGaN formed on the first surface region;

a cladding layer of a p-type GaN formed on the reverse-tunneling contact layer of  $n^+$ -type InGaN;

a multiple quantum well (MQW) light-emitting layer of InGaN formed on the cladding layer of a p-type GaN;

a cladding layer of n-type GaN formed on the MQW light-emitting layer of InGaN;

a first contact electrode formed on the cladding layer of n-type GaN;

a second electrode formed on the second surface region.